### *Section 23.1 Capacitors and Capacitive Reactance*

☐ 1. An ac voltage source that has a frequency $f$ is connected across the terminals of a capacitor. Which one of the following statements correctly indicates the effect on the capacitive reactance when the frequency is increased to $4f$?
(a) The capacitive reactance increases by a factor of four.
(b) The capacitive reactance increases by a factor of eight.
(c) The capacitive reactance is unchanged.
(d) The capacitive reactance decreases by a factor of eight.
(e) The capacitive reactance decreases by a factor of four.

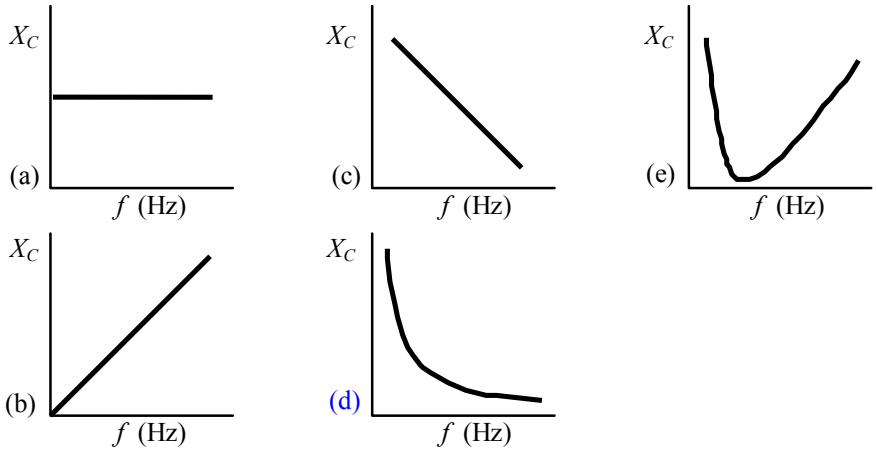
☐ 2. Which of the following units results when calculating the quantity, $\frac{1}{2\pi fC}$?

(a) F/s
(b) F · s
(c) Ω
(d) V
(e) Wb

◘ 4. A battery is used to drive a circuit. After a certain amount of time, the current is zero amperes. When the same circuit is driven by an ac generator, the current is non-zero and alternates. Which combination of elements is most likely to comprise the circuit?
(a) resistors only
(b) inductors only
(c) capacitors only
(d) a combination of inductors and resistors
(e) a combination of inductors and capacitors

◘ 5. Three 4.0-μF capacitors are connected in parallel across the terminals of a 120-Hz generator. What is the capacitive reactance of the circuit?
(a) 39 Ω
(b) 110 Ω
(c) 330 Ω
(d) 720 Ω
(e) $1.0 \times 10^3$ Ω

☐ 6. Which one of the following graphs illustrates how capacitive reactance varies with frequency?




◘ 7. A variable capacitor is connected to an ac source. What effect does *decreasing* the capacitance have on the reactance and current in this circuit?

*Reactance* *Current*

| | | |
|---|---|---|
| (a) | no change | no change |
| (b) | decreases | no change |
| (c) | increases | increases |
| (d) | decreases | increases |
| (e) | increases | decreases |

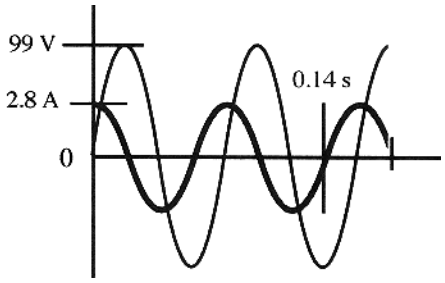
■ 8. The reactance of a capacitor at 110 Hz is 35 Ω. Determine the capacitance.
(a) 41 μF (c) 51 mF (e) 0.31 F
(b) 260 μF (d) 0.10 F

■ 9. What is the capacitive reactance of a circuit comprised of a 65.0-μF capacitor and a 50.0-Hz generator?
(a) 49.0 Ω (c) 97.6 Ω (e) 308 Ω
(b) 72.5 Ω (d) 145 Ω

■ 10. An ac generator is connected across the terminals of a 3.25-μF capacitor. Determine the frequency at which the capacitive reactance is 495 Ω.
(a) 60.0 Hz (c) 85.7 Hz (e) 152 Hz
(b) 72.4 Hz (d) 98.9 Hz

***Questions 12 through 16 pertain to the situation described below:***

The graph shows the voltage across and the current through a single circuit element connected to an ac generator.




■ 12. Determine the frequency of the generator.
(a) 0.14 Hz (d) 25.0 Hz
(b) 7.14 Hz (e) 50.0 Hz
(c) 12.5 Hz

■ 13. Determine the *rms* voltage across this element.
(a) 49.5 V (c) 112 V (e) 170 V
(b) 70.0 V (d) 140 V

■ 14. Determine the *rms* current through this element.
(a) 1.4 A (c) 3.4 A (e) 5.6 A
(b) 2.0 A (d) 3.9 A

■ 15. What is the reactance of this element?
(a) 20 Ω (c) 30 Ω (e) 40 Ω
(b) 25 Ω (d) 35 Ω

■ 16. Identify the circuit element.
(a) The element is a 25-Ω resistor.
(b) The element is a 35-Ω resistor.
(c) The element is a 0.45-H inductor.
(d) The element is a 360-μF capacitor.
(e) The element is a 510-μF capacitor.

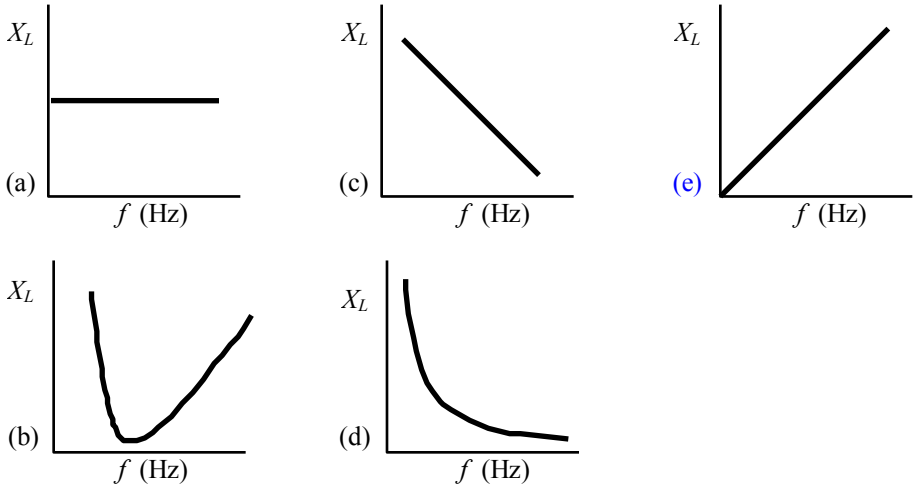
## *Section 23.2 Inductors and Inductive Reactance*

■ 17. When the frequency of an ac circuit is decreased, the current in the circuit increases. Which

combination of elements is most likely to comprise the circuit?
(a) resistors only (c) capacitors only (e) inductors and capacitors
(b) inductors only (d) capacitors and resistors

■ 18. Which circuit elements act to oppose *changes* in the current in an ac circuit?
(a) resistors only (d) both resistors and inductors
(b) capacitors only (e) both capacitors and resistors
(c) inductors only

□ 19. Which one of the following graphs shows how the inductive reactance varies with frequency?




■ 20. A variable inductor is connected to an ac source. What effect does *increasing* the inductance have on the reactance and current in this circuit?

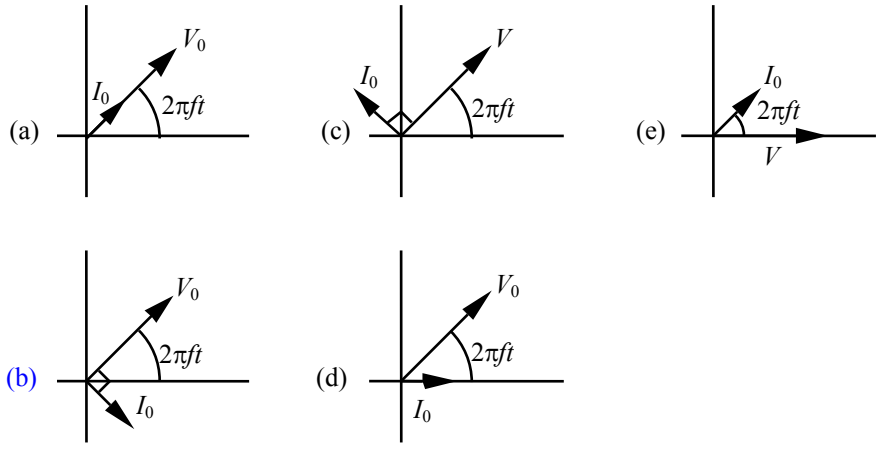
| | Reactance | Current |
|---|---|---|
| (a) | no change | no change |
| (b) | decreases | decreases |
| (c) | increases | increases |
| (d) | decreases | increases |
| (e) | increases | decreases |

□ 21. An ac voltage source that has a frequency $f$ is connected across the ends of an inductor. Which one of the following statements correctly indicates the effect on the inductive reactance when the frequency is increased to $2f$?
(a) The inductive reactance increases by a factor of two.
(b) The inductive reactance increases by a factor of four.
(c) The inductive reactance is unchanged.
(d) The inductive reactance decreases by a factor of four.
(e) The inductive reactance decreases by a factor of two.

■ 22. Two 0.18-H inductors and one 0.36-H inductor are connected in series across the terminals of a 50.0-Hz ac generator. What is the total inductive reactance of this circuit?
(a) 230 Ω (c) 88 Ω (e) 27 Ω
(b) 112 Ω (d) 56 Ω

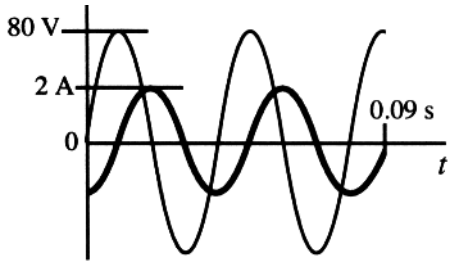
■ 23. In an ac circuit, a 0.025-H inductor is connected to a generator that has an rms voltage of 25 V and operates at 50.0 Hz. What is the rms current through the inductor?
(a) 0.62 A (c) 3.2 A (e) 14 A
(b) 2.0 A (d) 7.1 A

□ 24. Which one of the following phasor models correctly represents a circuit comprised of only an inductor and an ac generator?




***Questions 25 through 28 pertain to the situation described below:***

The voltage across and the current through a single circuit element connected to an ac generator are shown in the graph.




■ 25. Which one of the following statements concerning this circuit element is true?
(a) The element is a resistor.
(b) The element is a capacitor.
(c) The element is an inductor.
(d) The element could be a resistor or an inductor.
(e) The element could be an inductor or a capacitor.

◘ 26. At what frequency do charges oscillate in this circuit?
(a) 0.01 Hz (c) 0.09 Hz (e) 25 Hz
(b) 0.04 Hz (d) 11 Hz

◘ 27. Determine the *rms* current through this circuit element.
(a) 1.0 A (c) 2.0 A (e) 4.0 A
(b) 1.4 A (d) 2.8 A

◘ 28. Determine the reactance of this circuit element.
(a) 20 Ω (c) 40 Ω (e) 80 Ω
(b) 25 Ω (d) 57 Ω

## *Section 23.3 Circuits Containing Resistance, Capacitance, and Inductance*

□ 29. Which one of the following statements concerning an ac circuit is true?
(a) The current and voltage are *in phase* for a capacitor in an ac circuit.
(b) On average, the power dissipated by a resistor in an ac circuit is zero.
(c) For a resistor in an ac circuit, the current and voltage are 90° *out of phase*.
(d) Inductors in an ac circuit offer little opposition to current at high frequencies.
(e) When only resistance is present in an ac circuit, voltage and current are *in phase*.

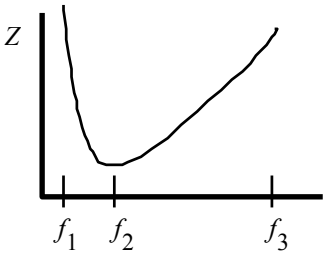
□ 30. Note the following circuit elements: (*1*) resistors, (*2*) capacitors, and (*3*) inductors. Which of these elements uses no energy, on average, in an ac circuit?
(a) *1* only (c) *3* only (e) both *1* and *3*
(b) *2* only (d) both *2* and *3*

□ 31. Which one of the following statements concerning the *impedance* of an *RCL* circuit is true?
(a) The impedance is dominated by the capacitance at low frequencies.
(b) The impedance is dominated by the resistance at high frequencies.
(c) The impedance depends only on the values of *C* and *L*.
(d) The impedance depends only on the resistance.
(e) The impedance is independent of frequency.

■ 34. The table below shows the values of the resistance, capacitive reactance and inductive reactance for five *RCL* circuits. In which circuit will the voltage lead the current?

| | ***Resistance*** | ***Capacitive reactance*** | ***Inductive reactance*** |
|---|---|---|---|
| (a) | 30 Ω | 219 Ω | 180 Ω |
| (b) | 50 Ω | 288 Ω | 244 Ω |
| (c) | 120 Ω | 58 Ω | 18 Ω |
| (d) | 150 Ω | 79 Ω | 212 Ω |
| (e) | 212 Ω | 314 Ω | 78 Ω |

◘ 35. The graph shows the impedance as a function of frequency for a series RCL circuit. At what frequency does the capacitor make the largest contribution?
(a) $f_1$ (d) $f_1$ or $f_3$
(b) $f_2$ (e) $f_1$ or $f_2$ or $f_3$
(c) $f_3$




■ 36. Complete the following statement: When the current in an oscillating *LC* circuit is zero,
(a) the charge on the capacitor is zero.
(b) the energy in the electric field is maximum.
(c) the energy in the magnetic field is a maximum.
(d) the charge is moving through the inductor.
(e) the energy is equally shared between the electric and magnetic fields.

□ 37. An ac circuit consists of a series combination of an inductor and a capacitor. What is the phase angle between the voltages across these two circuit elements?
(a) 0° (c) 180° (e) 360°
(b) 90° (d) 270°

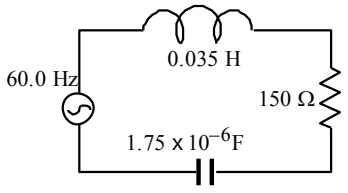
■ 38. The table below shows the values of the resistance, capacitive reactance, and inductive reactance for five *RCL* circuits. Which circuit will have a negative phase angle?

| | ***Resistance*** | ***Capacitive Reactance*** | ***Inductive Reactance*** |
|---|---|---|---|
| (a) | 78 Ω | 306 Ω | 346 Ω |
| (b) | 86 Ω | 49 Ω | 86 Ω |
| (c) | 120 Ω | 314 Ω | 314 Ω |
| (d) | 127 Ω | 218 Ω | 306 Ω |
| (e) | 148 Ω | 219 Ω | 180 Ω |

◘ 39. A series RCL circuit operating at 60.0 Hz contains a 35-Ω resistor and an 8.2-μF capacitor. If the

power factor of the circuit is +1.00, what is the inductance of the inductor in this circuit?
(a) 0.86 H (c) 2.3 H (e) 320 H
(b) 1.1 H (d) 57 H

■ 41. Use the information given in the figure for the series RCL circuit to determine the phase angle between the current and the voltage.
(a) zero degrees (d) –84°
(b) +5.3° (e) +90°
(c) –9.6°




◘ 42. A 7.70-μF capacitor and a 1250-Ω resistor are connected in series to a generator operating at 50.0 Hz and producing an *rms* voltage of 208 V. What is the average power dissipated in this circuit?
(a) 346 W (c) 19.7 W (e) zero watts
(b) 31.2 W (d) 1.66 W

***Questions 43 through 49 pertain to the ac circuit described below:***

An ac generator supplies a peak (not *rms*) voltage of 150 V at 60.0 Hz. The generator is connected in series with a 35-mH inductor, a 45-μF capacitor and an 85-Ω resistor.

◘ 43. Determine the *rms* voltage of the generator.
(a) 220 V (c) 82 V (e) 53 V
(b) 110 V (d) 75 V

◘ 44. What is the capacitive reactance for this circuit?
(a) 59 Ω (c) 99 Ω (e) 310 Ω
(b) 85 Ω (d) 120 Ω

◘ 45. What is the inductive reactance for this circuit?
(a) 13 Ω (c) 59 Ω (e) 99 Ω
(b) 23 Ω (d) 85 Ω

◘ 46. What is the impedance of the circuit?
(a) 13 Ω (c) 59 Ω (e) 97 Ω
(b) 23 Ω (d) 85 Ω

■ 47. Determine the *rms* current in the circuit.
(a) 0.28 A (c) 0.75 A (e) 1.6 A
(b) 0.40 A (d) 1.1 A

◘ 48. What is the *power factor* for this circuit?
(a) 0.47 (c) 0.64 (e) 28.3
(b) 0.54 (d) 0.88

■ 49. Which one of the following statements concerning this circuit is true?
(a) The voltage leads the current.
(b) The circuit is more capacitive than inductive.
(c) The voltage and current are exactly out of phase.
(d) The voltage and current are in phase.
(e) The phase angle for this circuit is positive.

***Questions 50 through 54 pertain to the ac circuit described below:***

The following table gives the reactance and rms voltage across the elements of a series RCL circuit:

| *Circuit element* | *Reactance* | *Voltage across element* |
|---|---|---|
| resistor | $2.00 \times 10^2\ \Omega$ | 86 V |
| capacitor | $6.63 \times 10^2\ \Omega$ | 285 V |
| inductor | $3.77 \times 10^2\ \Omega$ | 162 V |

■ 50. What is the *rms* current in the circuit?
(a) 0.25 A (c) 0.50 A (e) 1.08 A
(b) 0.43 A (d) 0.86 A

◘ 51. What is the impedance of the circuit?
(a) 11 Ω (c) 349 Ω (e) 1240 Ω
(b) 22 Ω (d) 486 Ω

■ 52. Determine the peak (*not rms*) voltage of the ac generator.
(a) 150 V (c) 300 V (e) 533 V
(b) 212 V (d) 414 V

◘ 53. What is the power factor for this circuit?
(a) 0.40 (c) 0.81 (e) 5.5
(b) 0.57 (d) 1.4

◘ 54. What is the average power consumed by the circuit?
(a) 37.0 W (c) 73.3 W (e) 129 W
(b) 64.5 W (d) 95.4 W